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A review of the radiometric ages of the Japanese granitic rocks

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Abstract: A review of 640 radiometric ages of Japanese granites show that the granitic rocks fall into 4 age groups—Paleozoic (430–250 m.y.), Triassic-Jurassic (240–180 m.y.), Cretaceous-Paleogene (130–40 m.y.) and Miocene (30–7 m.y.). The Paleozoic granites occur mostly as small bodies along tectonic lines such as the Kurosegawa and Nagato. The Triassic-Jurassic granites occur in the Hida geotectonic division and the Cretaceous-Paleogene granites, the largest group, occur mainly in the Honshu geotectonic division. Miocene granites are found in 4 getectonic divisions—the Shimanto, Hidaka, Green Tuff and Northwest Kyushu.

Ignoring the Paleozoic and Miocene granites of Northwest Kyushu, it appears that there is a tendency for granite ages to migrate torward the Pacific ocean. Within the Honshu granite division, however, there are also tendencies for granite ages to (a) migrate continentward and (b) parallel with the island arc axis. There is also a possibility the granite ages on both sides of the Tanakura Tectonic Line may be younging towards the Line. Within the Shimanto granite division there is also evidence for a migration of ages northwards.

INTRODUCTION

Recently the writer compiled a radiometric age map of the Japanese granites on which 640 age determinations are shown (Nozawa, 1975). The ages were obtained mainly by the K-Ar method. Several years ago, Kawano and Ueda (1967), Shibata (1968) and Nozawa (1968,1970) compiled the radiometric ages of the Japanese granitic rocks using K-Ar age data then available. Now the ages of almost all the granite masses in Japan have been determined by at least one of various methods of radiometric dating. This compilation is not greatly different from the earlier compilations, but gives a more comprehensive picture of the migration of plutonic activity.

FOUR AGE GROUPS OF JAPANESE GRANITIC ROCKS

The granitic rocks occupy about 12% of total land area of the Japanese Islands (Fig. 1) and are divided into four age groups (Fig. 2).

1. Paleozoic granites	430 – 250 m.y.
2. Triassic-Jurassic granites	240 – 180 m.y.
3. Cretaceous-Paleogene granites	130 – 40 m.y.
4. Miocene granites	30 – 7 m.y.

The Paleozoic granites are found only along some tectonic lines, such as the Kurosegawa and Nagato tectonic lines. They are mostly small lenses, several tens of meters wide and several hundreds of meters long and negligibly small in total amount. The Hikami Granite in Northeast Japan, which is as large as 10 X 5 Km , is the only exception.

The Triassic-Jurassic granites are exposed in the Hida geotectonic division, the oldest in Japan, is characterized by the Hida Metamorphic Rocks (Fig. 3). It is con-

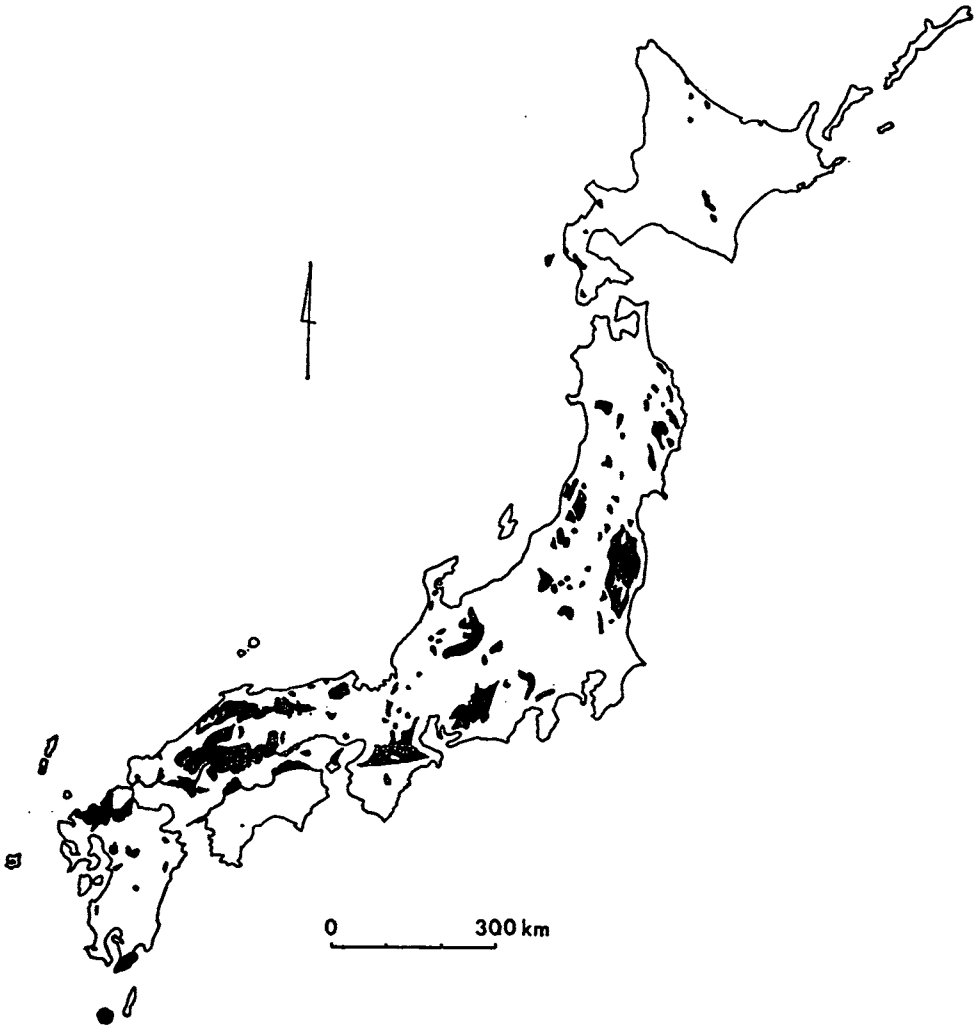

Fig. 1. Distribution of Japanese granitic rocks.

sidered that the Hida metamorphic rocks were formed in Late Paleozoic or Early Mesozoic and were mostly derived from Lower or Middle Paleozoic rocks. Some of the granites are large enough to warrant the term "batholith" and most have close relation to the Hida Metamorphic Rocks.

The Cretaceous-Paleogene granites are exposed mainly in the Honshu geotectonic division which is mostly made up of Upper Paleozoic and Mesozoic rocks (Fig. 3). The granite bodies there are the largest of those in the four age groups and comprise more than 60% of the granites exposed in Japan. Most of the granite masses are large and widely distributed from Hokkaido to Kyushu. Some are closely related to regional metamorphism, such as, Ryoke and Abukuma, whereas others seem to bear no relation to any regional metamorphism.

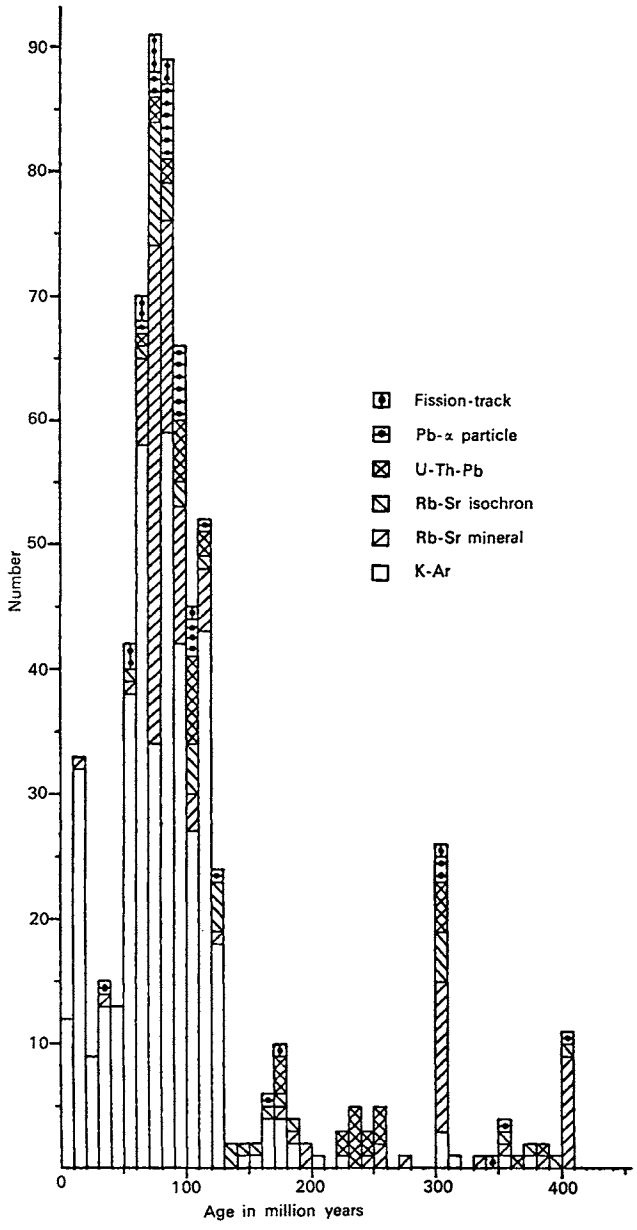

Fig. 2. Radiometric age histogram of Japanese granitic rocks.

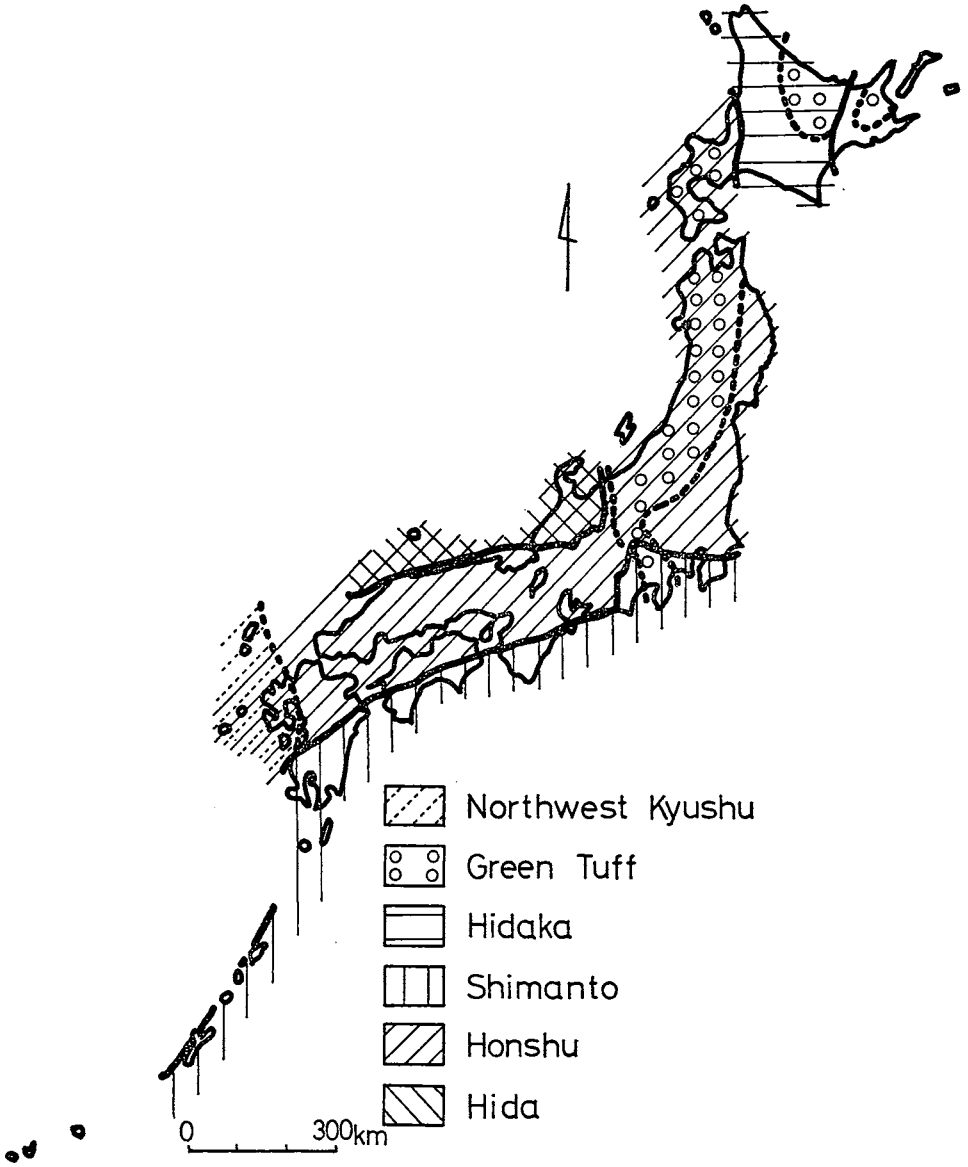

Fig. 3. Major granite division in relation to major geotectonic division of the Japanese Islands.

Miocene granites are found in the following four geotectonic divisions. In *Shimanto geotectonic division*, which consists of Cretaceous and Tertiary rocks, the Miocene granites are mostly small and rarely of batholithic dimensions (Fig. 3).

Hidaka geotectonic division contains Miocene granites of the Hidaka granite division. In the southern part of the division, the age goes back to Oligocene. The granites

are closely related to the Hidaka Metamorphic Rocks which were metamorphosed in the Cretaceous-Paleogene and were derived from Upper Mesozoic rocks.

The granites in *Green Tuff geotectonic division* are mostly small. The Green Tuff geotectonic division is made up mainly of Neogene rocks and has no exclusive territory of its own but overlaps other geotectonic divisions, such as, Hidaka, Honshu and Shimanto. The granites in the Green Tuff geotectonic division also overlap the other older granite divisions.

The *Northwest Kyushu granite division* occupies the northwestern part of Kyushu where Paleozoic and Tertiary rocks are exposed. It overlaps the Honshu granite division. Granites in this division are mostly small.

OCEAN-WARD MIGRATION OF AGES OF THE GRANITE PROVINCES

If we delete from consideration the minor Japanese granites, that is, the Paleozoic and Miocene granites of Northwest Kyushu and Green Tuff granite divisions, there is a distinct tendency of granite ages to become younger toward Pacific Ocean. In Northeast Japan, the older Honshu granite division, 130-60 m.y. old, is on the continental side and the younger Hidaka granite division, 30-10 m.y. old, is on the Pacific side (Fig 3). In Southwest Japan, the oldest is the Hida granite division, 240-180 m.y. old, on the continental side and the youngest is the Shimanto granite division, 20-13 m.y. old, on the Pacific side. Between these two divisions the Honshu granite division, having intermediate ages of 120-40 m.y. occupies a large area (Fig. 3).

MIGRATION OF AGES IN THE HONSHU GRANITE DIVISION

The largest division, Honshu granite division, displays some internal variations that oppose the large scale ocean-ward migration. In Southwest Japan, the ages of granites in the southern half of the Chugoku region are older, 100–80 m.y., and become younger toward north, 60–35 m.y. (Fig. 4 and 5). Similar tendency is also recognized in Chubu region but is not so distinct as in the Chugoku region In Northeast Japan, the Pacific side is older, 130–110 m.y. and the ages become younger toward west, 110–70 m.y. (Fig. 4 and 5). The continent-ward migration recognized in Southwest Japan and Northeast Japan is a characteristic of the Honshu granite division on a small scale, but is opposite to the ocean-ward migration of the major divisions.

The granite ages also show variations parallel with the island arc axis. In Southwest Japan, the K-Ar ages become younger toward northeast from Kyushu to Kanto. If we take the northern Chugoku region out of consideration, the average age of each region changes from 90 m.y. in Kyushu, through 80 m.y. in south Chugoku and 60 m.y in Kinki, to 50 m.y. in Chubu and Kanto. It is important to note that this migration is concordant with the migration of Cretaceous sedimentary basins in Southwest Japan.

In the earlier part of this paper, the migration of ages in Honshu granite division in Northeast Japan is interpreted as continent-ward migration, but there could be another possibility that it is southwestward lateral migration which is the counterpart of northeastward migration in Southwest Japan (Nozawa, 1970). If so, both sides of the Tanakura Tectonic Line (Fig. 4), which divides the pre-Neogene geology of Japanese Islands into Southwest Japan and Northeast Japan, show an age migration toward the Tanakura Tectonic Line.

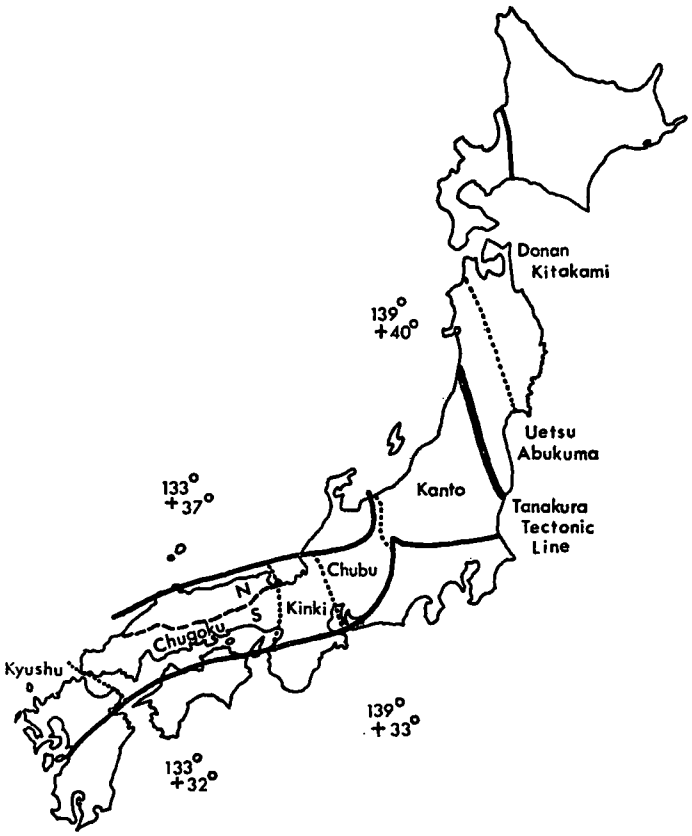

Fig. 4. Areal subdivision of Cretaceous-Paleogene granites in Japan.

The reason for the continent-ward migration of ages inside the Honshu granite division is not yet known but the age migration in the major granite divisions would probably follow the migration of geosynclines in and around the Japanese Islands. The variation of ages inside the Honshu granite division seems to correspond to some geochemical variation, for instance, in the Chugoku region, molybdenum belt in the north and tungsten belt in the south have closely similar age limits (Shibata and Ishihara, 1974). However, the genetic connection between geochemical and age variation is not yet established as a whole.

MIGRATION OF AGES IN THE SHIMANTO GRANITE DIVISION

The age distribution of Miocene granites shows no marked pattern except for the granites of the Shimanto granite division, wherein the ages migrate northward from the Ryukyu Islands, through Kyushu, Shikoku and Kishu to Kanto, from 20 m.y. to 8 m. y. (Nozawa, 1968). This northward migration of the granite age in the Shimanto granite division has the same sense of lateral migration as that of the Honshu granite division of Southwest Japan but is not so distinct.

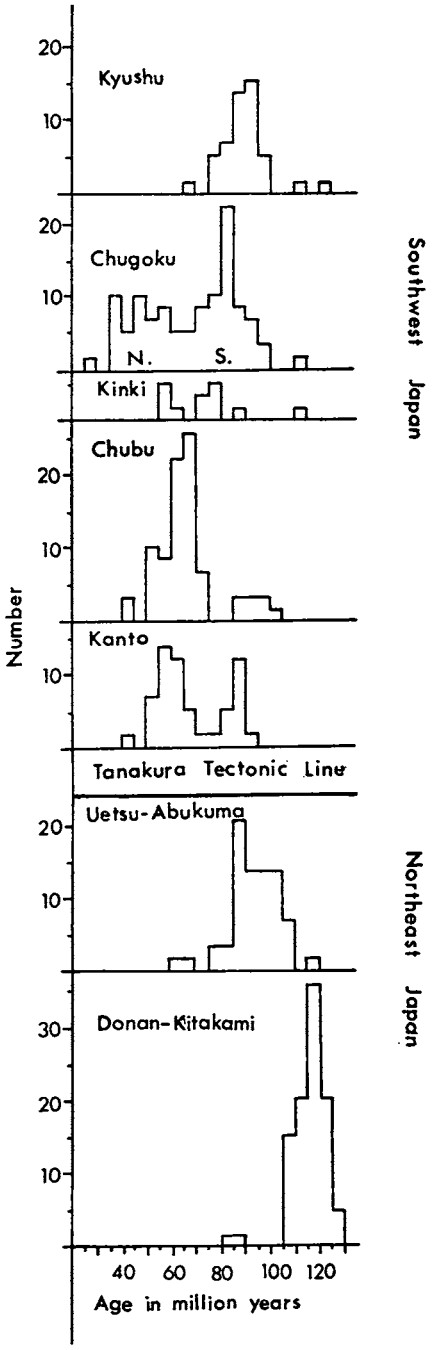

Fig. 5. Areal migration of K-Ar age of Cretaceous-Paleogene granites in Japan.

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REFERENCES

KAWANO, K. and UEDA, Y., 1967. Periods of the igneous activities of the granitic rocks in Japan by K-A dating method. *Tectonophysics, 4,* 523–530.

NOZAWA, T., 1968. Radiometric ages of granitic rocks in Outer zone of Southwest Japan and its extension; 1968 summary and north-shift hypothesis of igneous activity. *J. Geol. Soc. Japan, 74,* 485–489, (in Japanese).

NOZAWA, T., 1970. Isotopic ages of Late-Cretaceous acid rocks in Japanese Islands; summary and notes in 1970. *J. Geol. Soc. Japan, 76,* 493–518, (in Japanese).

NOZAWA, T., 1975. *Radiometric age map of Japan: Granite,* Geol. Surv. Japan. 1 : 2,000,000 Map series.

SHIBATA, K., 1968. K-Ar age determinations on granitic and metamorphic rocks in Japan. *Geol. Surv. Japan, Rept. No. 227,* 71p.

SHIBATA, K. and ISHIHARA, S., 1974. K-Ar ages of the major tungsten and molydenum deposits in Japan. *Econ. Geol. 69,* 1207–1214.