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K-Ar Ages of Granites from Amami-ōshima, Ryukyu Islands, Japan

By

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Abstract

K-Ar age measurements were made on four biotites separated from granites from Amami-ōshima, Ryukyu Islands. The ages range from 49 to 56 m.y., and they indicate that the granites were emplaced in Eocene, Tertiary.

Geological setting

Amami-ōshima is one of the islands on the Ryukyu arc, about 300 km south of Kyushu. Rocks exposed there are mainly sandstone, shale, chert and schalstein with thin layers of limestone. Small masses of granitic rocks are intruded into these sedimentary formations, and they are named Kasari granite, Yamma granite and Koniya granite.

The Kasari granite is biotite granodiorite, medium-grained, light-colored, non-gneissose, mostly homogeneous and poor in inclusion, except mylonitized part. Nearly half of it is

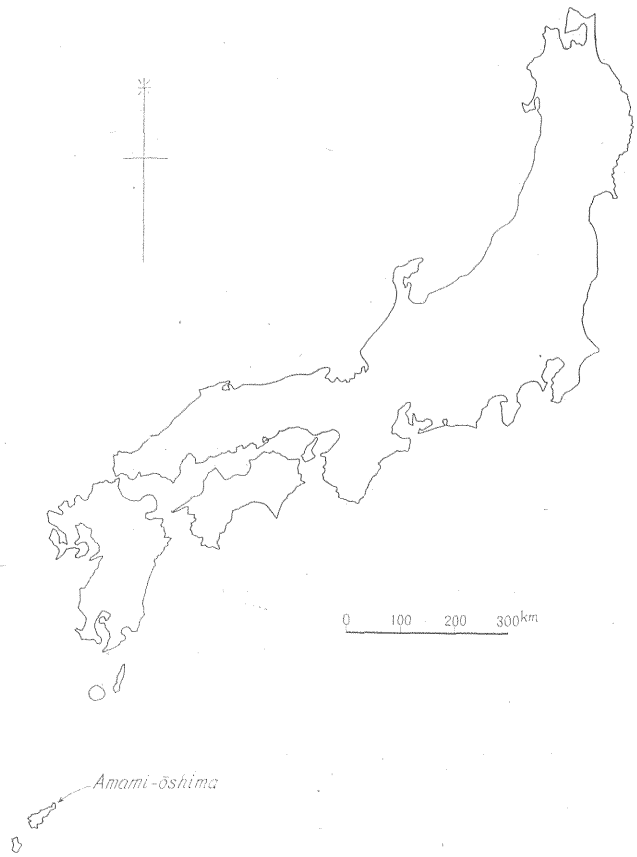

Fig. 1 Index to Amami-ōshima

mylonitized to various degree. The strongly mylonitized part is colored in grass-green and often appears as if a kind of basic rocks. It is elongated in shape, about 5 km long and 1 km wide, in NNE-SSW direction. It is intruded into the "Ōgachi shale formation" which contains no fossil evidence on age. But recently a boulder which contains Ammonite of Upper Cretaceous age was found in the distribution area of this formation (ISHIKAWA and YAMAGUCHI, 1965). Therefore, there is a strong possibility that the Ōgachi formation may be of Upper Cretaceous age. Contact is mylonitic and thermal effect is scarcely to be found.

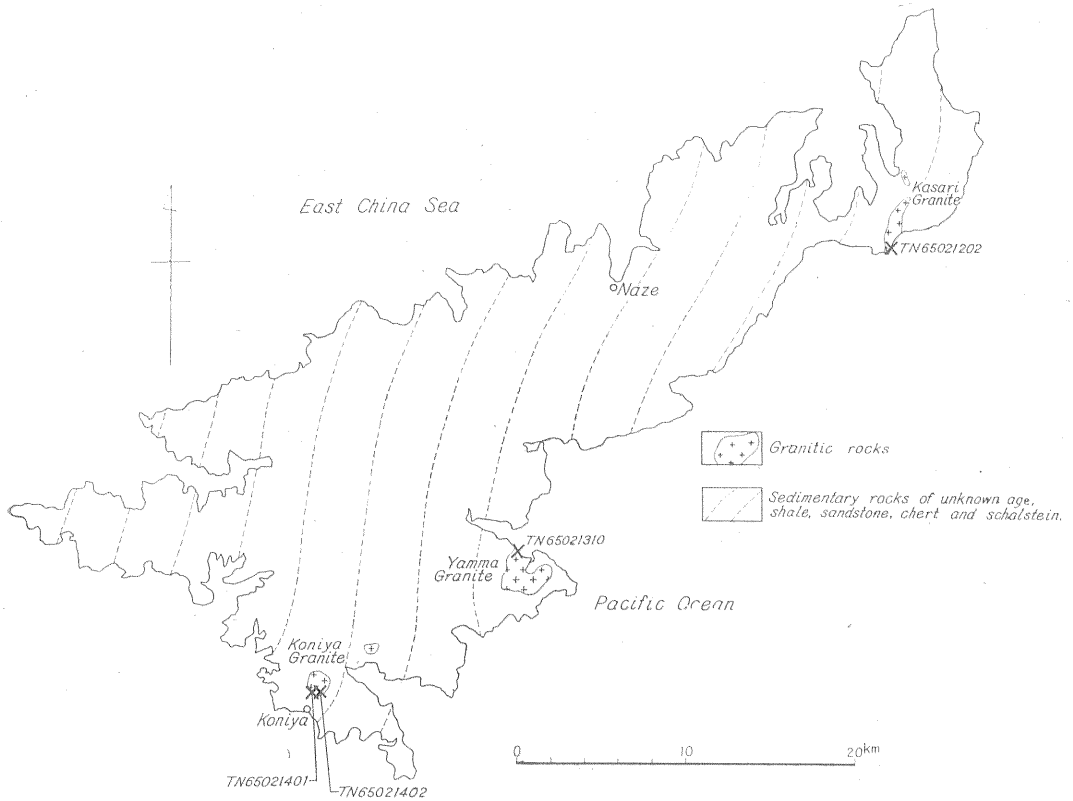

Fig. 2 Geologic map of the Amami-ōshima district

The Yamma granite is biotite quartzdiorite, fine-grained, greyish dark-colored, non-gneissose and somewhat heterogeneous. Besides quartzdiorite, granodiorite is reported in this granite mass, too (J. SUZUKI, 1937). Probably granodioritic part may be included in some part of it. It is round in shape, about 3 km across. It is intruded into the Ōgachi formation which is phyllitic in this neighborhood.

The Koniya granite is fine-grained biotite granodiorite, greyish dark-colored, non-gneissose, somewhat heterogeneous but poor in inclusion. It is a small mass, round in shape, about 2 km across. It is intruded into the "Ōtana sandstone formation". Its contact effect is not sure, but occurrence of cordierite biotite hornfels is reported by ŌBA (1959). The age of the Ōtana formation is not known because of lack of fossil evidence.

Description of the determined samples

(1) Biotite granodiorite (Kasari granite) (TN65021202)

Myōjinzaki, Ryūgō-mura, Ōshima-gun, Kagoshima pref.

It was taken from non-mylonitic part of the Kasari granite. It is light-colored, medium-grained, non-gneissose, homogeneous and free from inclusion. Under the microscope, it is composed mainly of biotite, plagioclase, potassium feldspar and quartz. Small quantities of tourmaline, apatite, iron ore and zircon are contained. Muscovite and chlorite are also contained as secondary minerals. Biotite is flaky, 0.5–2.0 mm long, and is severely altered

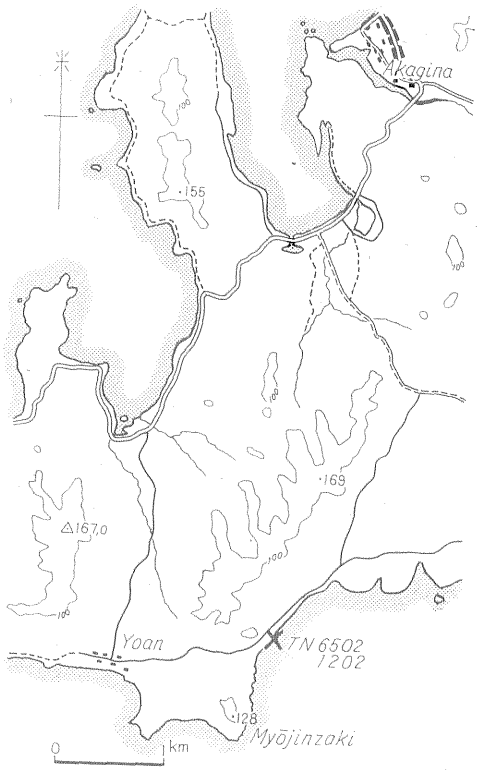

Fig. 3 Sample locality on the 1/50,000 topographic map, Akagina

to chlorite. Plagioclase is idiomorphic, prismatic, 1–3 mm long, and is oligoclase in composition. Potassium feldspar is allotriomorphic, 2–5 mm across, and is altered to some extent and perthite develops irregularly. Quartz is allotriomorphic, 2–5 mm across and graphic intergrowth with feldspar is often to be seen. Tourmaline is massive, 1–2 mm across, occurs in clot.

(2) Fine-grained biotite quartzdiorite (Yamma granite) (TN65021310)

Ichi, Sumiyo-mura, Ōshima-gun, Kagoshima pref.

It is fine-grained, greyish dark-colored, non-gneissose, homogeneous, free from inclusion and is strikingly fresh in comparison to other granitic rocks in this island. Under the microscope, it is composed mainly of biotite, plagioclase and quartz. Small quantities of iron ore, apatite and zircon are contained. Biotite is fresh and flaky, 0.5–1.5 mm long, with pleochroism, X: nearly colorless, Y, Z: brown, a little reddish. Plagioclase is idiomorphic, prismatic, 0.2–1.0 mm long, and basic oligoclase in composition. Quartz is allotriomorphic, 0.5–1.5 mm across. Zircon gives strong halo to biotite in contact.

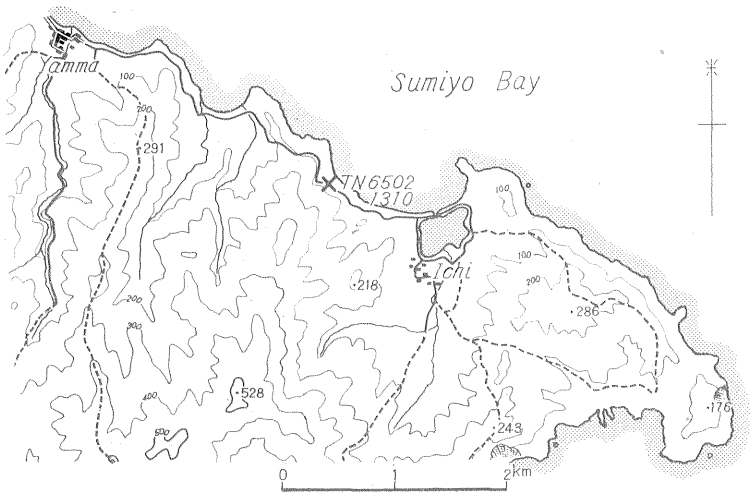

Fig. 4 Sample locality on the 1/50,000 topographic map, Yuwan

(3) Fine-grained biotite granodiorite (Koniya granite) (TN65021402)
Jitō-tōge, Koniya, Setouchi-chō, Ōshima-gun, Kagoshima pref.

It is fine-grained, greyish dark-colored, non-gneissose, homogeneous, free from inclusion and gives porphyritic appearance by relatively large crystals of feldspar. Under the microscope, it is composed mainly of biotite, plagioclase, quartz and potassium feldspar. Small

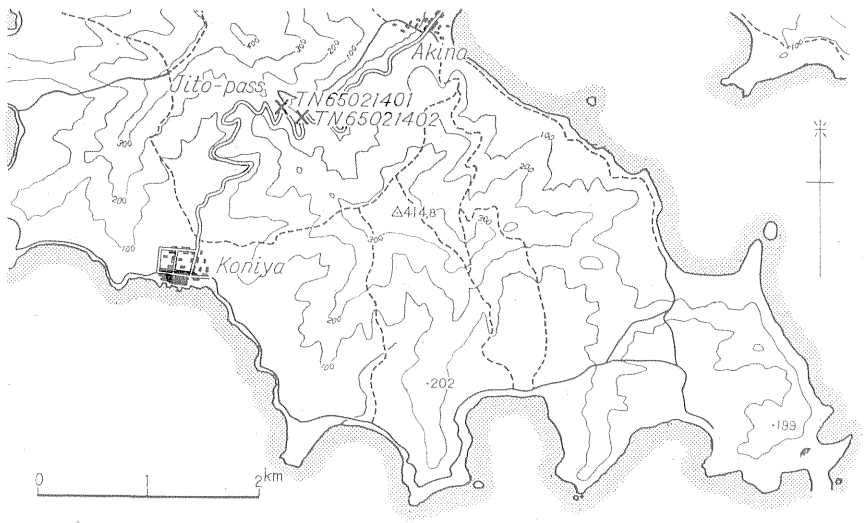

Fig. 5 Sample localities on the 1/50,000 topographic map, Koniya

quantities of iron ore, apatite and zircon are contained. Prehnite and chlorite occur as secondary minerals. Prehnite veinlets are often found. Phenocrystic plagioclase is nearly idiomorphic, 5–8 mm across, altered to some extent, and is andesine or basic oligoclase in composition. Some of plagioclase is replaced by potassium feldspar. Quartz is also large but allotriomorphic, 0.3–0.6 mm across. Matrix is composed mainly of fine-grained biotite and plagioclase. Biotite is flaky, 0.2–1.0 mm long, and includes plagioclase crystals. Biotite is altered to some extent yielding chlorite and prehnite. Plagioclase is idiomorphic, prismatic,

0.1–0.3 mm long, and is somewhat decomposed and is andesine in composition. Potassium feldspar is allotriomorphic, 0.2–0.5 mm across.

(4) Fine-grained biotite granodiorite (Koniya granite) (TN65021401)

Nearly the same locality as (3), about 300 m west

It is coarser-grained facies of the Koniya granite and is quite similar to the sample (3) except grain-size, and is relatively fresh. Under the microscope, phenocrystic plagioclase is idiomorphic, 2–8 mm across, partly replaced by potassium feldspar. Biotite in the matrix is relatively fresh, with pleochroism, X: pale brown, Y, Z: deep brown. Tourmaline clot is found rarely.

Experimental procedures

K–Ar age determinations were made on the biotites separated from the rock samples, using the isotope dilution technique.

Separation of the biotites was carried out with an isodynamic separator after crushing and sieving.

Argon extraction and purification were made in the pyrex high vacuum system. The biotite was fused in a molybdenum crucible at about 1300°C for 30 minutes with an induction heater. The Ar^{38} spike was added during fusion, and evolved gases were purified by hot titanium sponge. The isotopic ratios of argon were measured with the Mitsubishi MS-315 mass spectrometer by the static method.

Potassium determination was made by flame photometry. Each sample was measured in duplicate except No. TN65021202 sample, on which four separate determinations were made.

The results of K–Ar age measurements are given in Table 1.

Table 1 Results of K–Ar age measurements

Sample No.	Mass	Mineral	K_2O (%)	Atmospheric contamination (%)	Age and error (million years)
TN 65021202	Kasari	biotite	1.07	46.7	49±6
TN 65021310	Yamma	biotite	7.52	39.7	55±4
TN 65021402	Koniya	biotite	4.86	10.5	56±3
TN 65021401	Koniya	biotite	2.90	20.6	54±3

$\lambda_\beta = 4.72 \times 10^{-10}$ yr.$^{-1}$, $\lambda_e = 0.584 \times 10^{-10}$ yr.$^{-1}$

Geological meaning of the results

The results, 49, 55, 56 and 54 million years give good agreement to each other and are correlated to Eocene, Tertiary. Thus the granitic rocks in Amami-ōshima possibly belong to the contemporaneous plutonism, probably to the same plutonism, in spite of their petrographic difference. In Tokunoshima Island, 40 km south of Amami-ōshima, there are granitic rocks 63.5 million years old after potassium-argon method on biotite (KAWANO and UEDA, 1965*).

Formerly HANZAWA (1935) thought these granitic rocks to be of late Paleozoic or early Mesozoic age. J. SUZUKI (1937) tries comparison of these granitic rocks to those in the Outer Zone of Southwest Japan. Y. SUZUKI (1954) treats these granitic rocks as members of the

* Read before the 72nd annual meeting of the Geological Society of Japan.

Outer Zone granites. ŌBA (1959), too, points out the similarity of petrographic and chemical character of these granitic rocks and the Outer Zone granites. KONISHI (1965) proposes geotectonic zoning on the Ryukyu Islands in which granites of Kasari and Yamma are on "Kunigami belt" and granites of Koniya and Tokunoshima are on "Motobu belt". And he suggests that most of these granitic rocks may be of Miocene and there is a possibility of occurrence of some older granites in the Motobu belt.

According to the potassium-argon age on biotite, the Outer Zone granites in Kyushu are correlated to Miocene or Pliocene (MILLER et al., 1962). Then, there arises a possibility that granitic rocks on the Ryukyu arc may belong to different plutonism from the Outer Zone granites. It is to be noted that there are some granitic rocks of similar potassium-argon age in the Inner Zone of Southwest Japan, such as in Chūgoku region and Naégi region.

More precise study is wanted on these relations, petrographically as well as geologically.

Acknowledgement

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奄美大島花崗岩の K-Ar 年代

柴田　賢　野沢　保

要　旨

奄美大島の4個の花崗岩から分離した黒雲母について，K-Ar 法による年代測定を行なった。求められた年代 49，55，54，56×10^6 年は，これらの花崗岩が第三紀始新世に迸入したことを示す。