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K-Ar Age of the Granodiorite in a Pit of the Amo Mine, Hida Mountains, Japan

By

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Abstract

K-Ar age determination was carried out on a biotite separated from the granodiorite in a pit of the Amo mine, Hida mountains. The age of 167 m. y. is correlated to the middle Jurassic, and it is reasonable to attribute this granodiorite to the main plutonism of the Hida metamorphic belt.

Geological setting

The Hida metamorphic belt is one of the oldest metamorphic belts in the Japanese Islands and is exposed in the northernmost zone in the zonal arrangement of basement rocks in Southwest Japan. For these twenty years controversy has been continued on the age problem of the Hida metamorphic rocks. Some authors believe it to be Mesozoic age and some others insist on Precambrian age.

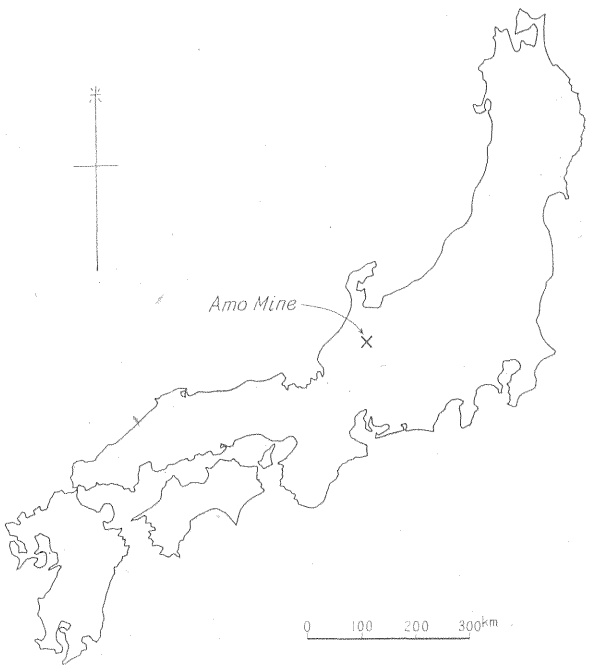


Fig. 1 Index to the Amo Mine area

In this metamorphic belt, there are exposed a lot of granitic rocks accompanied by gneiss and schist. Most of the granitic rocks are grouped in two; one is reddish pink colored granodiorite and its allied rocks, called "Funatsu type", and the other is a little darker colored quartzdiorite and its allied rocks, called "Shimonomoto type". These two

are considered to belong to one plutonism and are named "Funatsu granitic rocks" together. The Funatsu granitic rocks are intruded into the gneiss in the north and into the Paleozoic formation in the south.

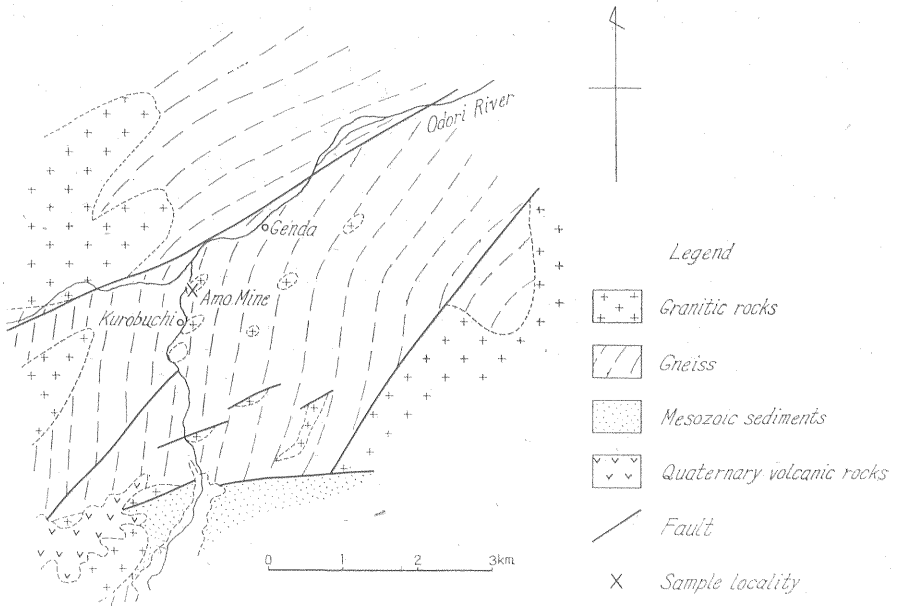
Besides the Funatsu granite, there are some other granitic masses of much smaller quantity which apparently belong to neither of two types of the Funatsu granitic rocks. They are exposed as small masses in the gneiss area but are not in the Paleozoic area. Typical two of this kind of granitic rocks are found near the Amo mine. One is called "Amo granite" and has concordant shape to the surrounding gneiss. It is light-colored, coarse-grained, heterogeneous with abundant inclusions of gneiss and is characterized by bluish purple tint of quartz and feldspar.

The other one has, in contrast to the Amo granite, round outline discordant to the gneiss. It is medium- or fine-grained, light-colored, not pink- nor purple-colored, relatively homogeneous and nearly free from xenolithic inclusions of gneiss. So, it was once believed that the Amo granite might be a synkinematic granite and the latter had a possibility of quite younger intrusion independent of the Hida metamorphism.

A sample for the present study was taken from the latter.

Fig. 2 Distribution of granitic rocks in the Hida metamorphic belt

(Figures are previous data on their isotopic ages, in million years, including unpublished data after H. Nagasawa et al., cited here by their courtesy.)



Fig, 3 Geologic map of the Amo Mine district

Description of the determined sample

Biotite granodiorite (TN 61091401)

Amo mine, Genda, Kawai-mura, Yoshiki-gun, Gifu pref.

It was taken from a small stock of granodiorite in a pit of the Amo mine. This granodiorite is in contact with biotite gneiss with discordant and steep boundary on the roadside from the mine to Kurobuchi. On the other hand, in a pit of the mine, gradual transition

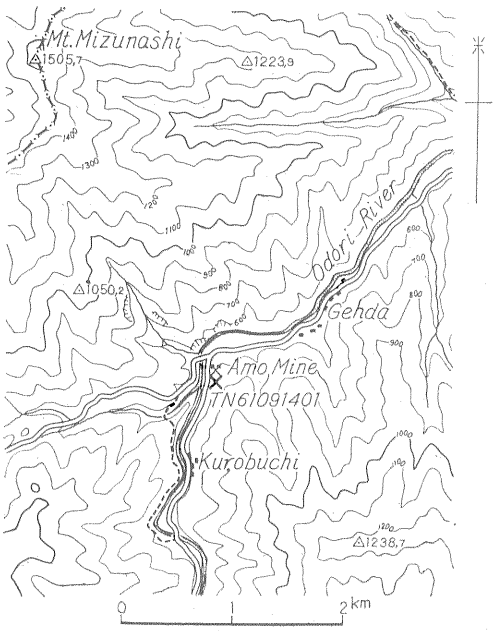


Fig. 4 Sample Locality on the 1/50,000 topographic map, Hidafurukawa

with a narrow transitional zone is observed. In both cases, contact effect on the neighboring gneiss is not conspicuous.

It is light-colored, non-gneissose, medium-grained, homogeneous and nearly free from inclusion.

Under the microscope, it is composed mainly of biotite, plagioclase, quartz and microcline. Small quantities of apatite, iron ore, sphene and zircon are contained as well. Biotite is hypidiomorphic, 1–3 mm across, with pleochroism, X: pale greenish brown, Y, Z: reddish brown. It is to be noted that most of the biotite is chloritized to some extent accompanying prehnite, sphene and iron ore. Plagioclase is idiomorphic or hypidiomorphic, 2–3 mm across, commonly zoned without sharp boundary and its composition is nearly of oligoclase on the periphery of the zoned crystal. Quartz is granular or allotriomorphic, 1–3 mm across. Microcline is always allotriomorphic, 2–4 mm across, showing beautiful microcline structure with weakly developed perthite blebs.

Experimental procedures

K–Ar age determination was made on the biotite separated from the rock sample, using the isotope dilution technique.

Separation of the biotite 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 in a molybdenum crucible was fused 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 and CuO. The isotopic ratios of argon were measured with the Hitachi RMU–5B mass spectrometer by the flow method.

Potassium determination was made by flame photometry. The biotite was digested with HF and HCl, the residue was dissolved in HCl and diluted to a standard volume, and potassium content was measured with the Hitachi EPU–2 flame photometer.

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

Table 1 K–Ar age of the granodiorite in a pit of the Amo mine

Sample No.	Mineral	K_2O (%)	Atmospheric contamination (%)	Age and error (million years)
TN61091401	biotite	2.40	17.2	167±12

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

Geological meaning of the result

The result, 167 million years is correlated to middle Jurassic age. It is to be noted that the determination was carried out on a sample which is to some extent altered and its content of potassium is so low that there remains a possibility that the true age is a little older than the result gained. Anyhow, it is unreasonable to take this granodiorite away from the plutonic history of the Hida metamorphic belt. As to the relation with the Funatsu granitic rocks, of which K–Ar age is early Jurassic, this granodiorite is supposed to belong to the same plutonism but their direct relation is not observed in the field (KUNO,

H. et al., 1960 and NAGASAWA, H. et al., unpublished data*).

There are several granitic rocks similar to that treated in the present paper throughout the Hida metamorphic belt, especially in the neighborhood of the Amo mine.

By the way, K-Ar age of the Hida metamorphic rocks on biotite is similar to the Funatsu granitic rocks, early Jurassic (KUNO, H. et al., 1960). There is a little different result by the same method on hornblende that gives two ages: one is nearly the same as the biotite age and the other is older, late Carboniferous or early Permian age (OHMOTO, H., 1964). The whole history of the Hida metamorphic belt is not established yet.

Acknowledgements

The authors wish to thank Dr. H. NAGASAWA of Gakushuin University for the kind assistance in preparing Ar^{38} spike. Thanks are also due to Dr. H. NAGASAWA and his colleagues for their permission to cite their unpublished data.

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飛騨天生鉱山坑内の花崗閃緑岩の K-Ar 年代

柴田　賢　野沢　保

要　旨

飛騨山地天生鉱山の坑内で採取した花崗閃緑岩の黒雲母について，K-Ar 法による年代測定を実施した。求められた年代 167×10^6 年はジュラ紀中期を示す。

* Cited here by their courtesy.