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K–Ar Ages of Metamorphic Rocks at the Top of Mt. Tanigawa-dake, Central Japan

By

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Abstract K-Ar ages of the high-pressure metamorphic rocks, occurring at the top of Mt. Tanigawa-dake, were obtained. The ages are 308 and 289 Ma. Although these values may have been underestimated to some extent due to contact metamorphism by the Cretaceous to Tertiary granitic intrusions, the data support that the metamorphic rocks and surrounding ultramafic rocks in Mt. Tanigawa-dake are the same as the constituents of the Hida marginal belt.

Introduction

Sanbagawa metamorphic belt and Jurassic to Cretaceous subduction belts are well recognized at both eastern and western sides of the Itoigawa-Shizuoka Tectonic Line (Fig. 1). However, eastern extensions of Hida belt and its marginal parts have not been well confirmed.

In the Joetsu area. Maeda (1962) described metamorphic rocks as inclusions in the ultramafic rocks at the top of Mt. Tanigawa-dake. He reported that the metamorphic rocks are similar to those in the Hida marginal and Sangun belts. Hayama *et al.* (1969) summarized metamorphic and sedimentary rocks occurring sporadically in the Joetsu region and concluded that the metamorphic rocks belong to those of the Hida marginal and Sangun belts. On the other hand, Komatsu *et al.* (1985) concluded that the metamorphic rocks are similar to those in the Sangun belt, rather than those in the Hida marginal belt.

In this study, we obtained K–Ar ages of the metamorphic rocks and discussed the western counterpart of the metamorphic rocks.

Description of the Samples

Large ultramafic body occurs in Mt. Tanigawa-dake. Metamorphic rocks are observed as inclusions in the ultramafic rock at the top of Mt. Tanigawa-dake. They are coarse-grained pelitic and basic rocks with albite porpyroblasts (Fig. 2). As already noted by Hayama *et al.* (1969), they are somewhat suffered from contact metamorphism by Cretaceous to Tertiary granitic intrusions.

The pelitic rocks are composed mainly of quartz, albite, muscovite and and garnet.

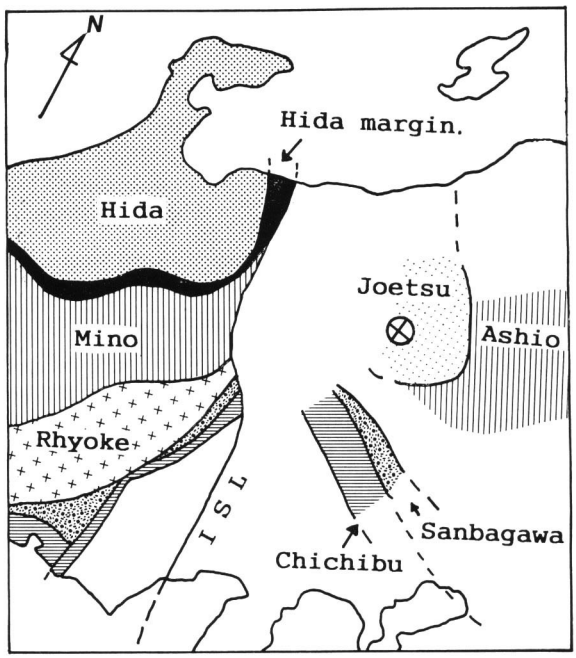

Fig. 1. Geological framework of Central Japan. cross; Mt. Tanigawa-dake, ISL; Itoigawa-Shizuoka Tectonic Line.

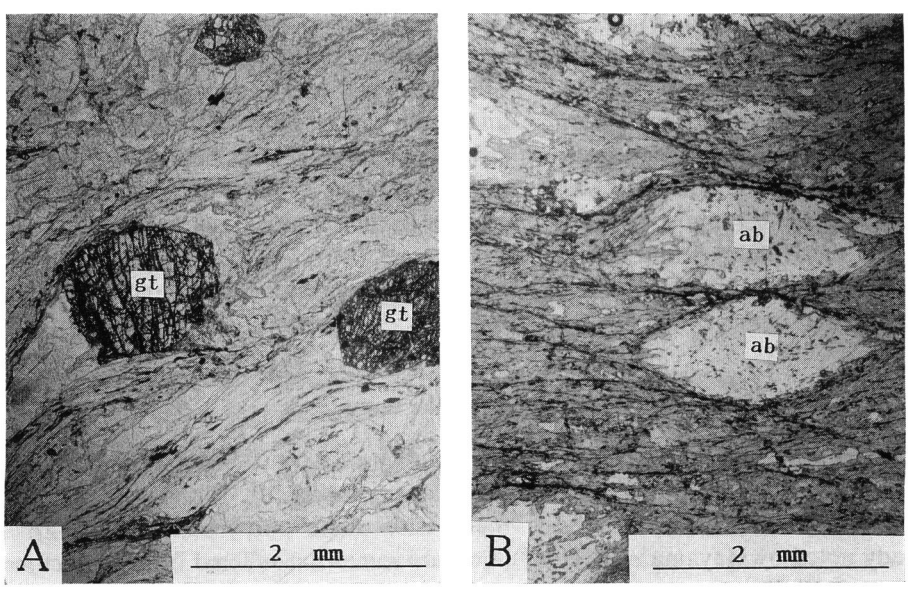

Fig. 2. Microphotographs of the metamorphic rokcs in Mt. Tanigawa-dake. A; pelitic rock. B; basic rock. gt; garnet, ab; albite.

Effect of the contact metamorphism are different from sample to sample. Newly crystallized minerals are chlorite, calcic plagioclase and epidote. Chlorite and epidote replace garnet. Calcic plagioclase occurs mostly as a pool or vein.

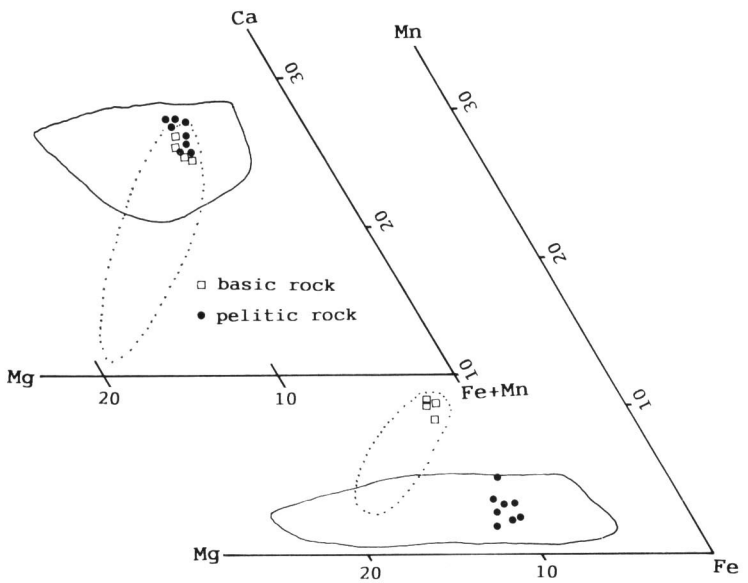

Fig. 3. Compositions of garnets plotted in ternary diagrams. Areas enclosed by solid lines are compositional fields of granet rims in pelitic rocks from the biotite zone in the Sanbagawa metamorphic belt (Higashino, 1992). Areas by dotted lines are those in the basic rocks in the Hida marginal belt (Nakamizu *et al.* 1989).

Table 1. Chemical compositions of the representative minerals

sample	121625 pelitic rock		9912 basic rock		121623 basic rock
mineral	garnet core	garnet rim	garnet core	garnet rim	amphibole
SiO_2	37.61	37.68	38.54	38.18	45.55
TiO_2	0.16	0.16	0.18	0.26	0.37
Al_2O_3	20.73	21.53	21.25	21.06	11.68
FeO*	29.27	27.77	26.96	26.18	16.11
MnO	1.81	0.75	3.17	3.32	0.33
MgO	1.84	1.97	2.26	2.07	10.96
CaO	9.48	10.09	9.86	10.10	10.39
Na_2O					2.68
K_2O					0.31
Total	100.90	99.95	102.22	101.17	98.38

* Total Fe as FeO

Two samples selected for the K-Ar ages are less altered pelitic rocks. One is almost free from the later stage minerals. As shown in Fig. 2A, garnet is well preserved and coarse-grained. The other sample is somewhat altered, especially in garnet. Garnet is highly replaced by chlorite. Plagioclase occurs locally along the velin in latter sample.

Basic rocks are composed mainly of hornblende, albite, garnet and epidote. Albite forms usually porphyroblast. Later stage minerals are chlorite, plagioclase (An50), K-feldspar and amphibole. Garnet is strongly replaced by chlorite. Plagioclase and late stage amphibole occur as a poor or vein. K-feldspar locally occurs along the vein.

Plagioclase occurring as a porpyroblast is usually pure albite, $NaAlSi_3O_8$, in both pelitic and basic rocks. Garnets in the pelitic and basic rocks are similar in composition to those in the Sanbagawa metamorphic and Hida marginal belts, respectively (Fig. 3 and Table 1). Amphiboles in the basic rocks are to some extent subcalcic, *i.e.* depleted in CaO. Hence it is reasonable that the metamorphic rocks belong to the high-pressure type, as discussed by Hayama *et al.* (1969).

Result and Discussion

K-Ar ages of muscovites are 308 Ma for the relatively fresh sample and 284 Ma for the somewhat altered sample (Table 2). Contact metamorphism by the Cretaceous to Tertiary granitic intrusions, if present, should reduce the values.

Before the determination of isotope ages of many metamorphic rocks in the Hida marginal and Sangun belts, both belts have not been clearly distinguished each other. Therefore, Maeda (1962) and Hayama *et al.* (1969) suggested that the metamorphic rocks at Mt. Tanigawa-dake are similar to those in the Hida marginal and Sangun belts. After many analyses clarified the differences of the isotope ages between the metamorphic rocks of two belts, Komatsu *et al.* (1985) concluded that the metamorphic rocks at Mt. Tanigawa-dake are constituents of the Sangun belt, rather than those in the Hida marginal belt. Recently Shibata and Nishimura (1989) suggested that a part of the Sangun belt is similar in isotope ages to the Hida marginal belt.

K-Ar ages of metamorphic rocks in the Hida marginal Belt are mostly more than 300 MA (e.g. Shibata and Nishimura, 1989), whereas those in the Sangun belt are

Table 2. K-Ar ages of muscovites in the pelitic rocks

Sample	Material analyzed	^{40}Ar (scc/gm $\times 10^{-5}$)	^{40}Ar (%)	K (%)	Isotope age (Ma)
121625	muscovite	7.46	98.3	5.68	308±15
		7.30	98.2	5.63	
121626	muscovite	7.29	98.4	6.01	284±14
		7.05	97.8	5.97	

Analyses by Teledyne Isotopes

mostly from 170–230 Ma, far less than 300 MA (e.g. Shibata and Nishimura, 1989; Nishimura and Shibata, 1989). Hence even if the K-Ar ages of the metamorphic rocks studied here were underestimated by the contact metamorphism and the real metamorphic ages were more than 308 and 284 MA, the isotope ages suggest that the metamorphic rocks are well corresponding to those in the Hida marginal belt. As far as Central Japan is concerned, there is no high pressure metamorphic rock with isotope age greater than 200 Ma. Hence, it is reasonable to conclude that the metamorphic rocks and surrounding ultramafic rocks in Mt. Tanigawa-dake belong to the constituents of the Hida marginal belt.

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