FINDING OF PLAGIOCLASE-BEARING GRANULITE FROM THE IRATSU EPIDOTE AMPHIBOLITE MASS IN CENTRAL SHIKOKU

KAZUMI YOKOYAMA*

(Received January 8, 1976)

Amphibolites associated with alpine-ultramafic rocks are reported from many localities such as Tinaquillo (MACKENZIE, 1960), Lizard (GREEN, 1964) and Dinaride (PAMIC *et al.*, 1973). TAYLER (1967) and PAMIC *et al.* (1973) have suggested that such an amphibolite was a metamorphosed gabbro associated with a peridotite, while GREEN (1964) has considered that it was a country rock metamorphosed by the intrusion of high temperature peridotite. The original rock-types of these amphibolites have rarely been confirmed, however. The Iratsu epidote amphibolite mass situated in the Sanbagawa metamorphic belt in Central Shikoku has similarities with the above mentioned amphibolites in the sense that it forms a large metabasite mass, associated with peridotite, metamorphosed more or less under the same condition as the enclosing basic and pelitic schists, but it is a distinctive geological unit suggesting a genesis different from the neighbouring basic schists. The idea that this epidote amphibolite mass is a metamorphosed gabbro has been put forward by HORIKOSHI (1937) and SHIBATA (1972) and others.

Recently, petrographic evidences suggesting that the epidote amphibolite was once a metabasite complex of the granulite facies have been found. YOKOYAMA & MORI (1975) have described spinel-aluminous pyroxene-bearing rocks from the Iratsu complex. They are granulite facies rocks in part recrystallized under the epidote amphibolite facies, *i.e.* the same metamorphic facies as the surrounding schists. They considered that the zoisite-kyanite-quartz aggregate associated with spinel

and aluminous pyroxenes in the granulite is metamorphosed anorthositic plagioclase. This assemblage is not uncommon in the complex, but original plagioclase has not been confirmed yet. During the field work in summer of 1975, the author found that not only metamorphosed aggregate but also original plagioclase itself are preserved in the epidote amphibolite mass. As this finding is important on the genesis of the epidote amphibolite, its mode of occurrence will be described below together with mineralogical data.

Granulites containing anorthositic plagioclase in question are rounded blocks with 10—80 cms in diameter and included in a large epidote amphibolite block (Plates I-A, B and C) on the river-bed of the Nikubuchi valley. The granulite has a granoblastic texture, consisting of plagioclase and pyroxenes with small amount of hornblende, zoisite, kyanite and quartz. It is composed of pyroxene-rich and plagioclase-rich bands (1—3 cms in width) (Plate I-B). Plagioclase and pyroxenes occur as equigranular granoblastic mosaic. They show no preferred orientation. The rim of the plagioclase crystals are replaced by the aggregate of zoisite, kyanite and quartz (Plate I-D). Hornblende is present only at the interstices among plagioclase and pyroxenes. Zoisite, kyanite, quartz and hornblende are common minerals of the Iratsu epidote amphibolite mass.

From these relations, these minerals are believed to be reaction products among plagioclase and pyroxenes during the metamorphism of the epidote amphibolite facies. Therefore it is considered that the granulite originally consisted of plagioclase and pyro-

* Geological Institute, University of Tokyo.

Table 1. Chemical compositions of the minerals.

	plagioclase	orthopyroxene	clinopyroxene
SiO ₂	44.75	52.24	50.76
Al ₂ O ₃	35.62	4.60	5.15
TiO ₂	0.00	0.04	0.25
FeO*	0.03	14.99	5.32
MnO	0.01	0.34	0.15
MgO	0.05	27.42	14.54
CaO	18.90	0.40	23.65
Na ₂ O	1.06	0.01	0.50
K ₂ O	0.01	0.02	0.02
Total	100.44	100.06	100.01

by electron microprobe analyser

* total Fe as FeO

xenes. The surrounding epidote amphibolite shows gneissose texture. Amphibole and epidote show faint preferred orientation. The textures of the epidote amphibolites enclosing the granulite are identical to the epidote amphibolite in the Iratsu mass. The contact between the granulite and epidote amphibolite is mostly very sharp as seen in Plate I, occasionally the boundary is zig-zag. Pyroxene-rich bands in granulite are convex to the epidote amphibolite and connected with amphibole-rich bands of the epidote amphibolite, while plagioclase-rich bands are concave to the epidote amphibolite and connected with epidote-rich bands. These relations clearly show that some epidote amphibolites were derived from granulites.

Chemical composition of the minerals were determined using electron microprobe analyser. The results are shown in Table 1. Plagioclase is almost homogeneous with An=89—91%. Pyroxenes are aluminous (4—6 wt% in Al₂O₃ content). These chemical features and textures of the minerals are similar to those in spinel-bearing granulites described by YOKOYAMA & MORI (1975). Their discussion on P, T conditions of the spinel-bearing granulites and relations among spinel, plagioclase and pyroxenes to form epidote, amphibole and garnet can also be applied to the genesis of this granulite. According to YOKOYAMA and MORI (1975), spinel-bearing granulites originally consisted of spinel, plagioclase and pyroxenes and were formed under a condition of 600—700°C at

the granulite facies. Partition coefficient $K_{\text{opx-cpx}}^{\text{Fe-Mg}}$ as a geothermometer (YOKOYAMA & MORI, 1975) is 1.5 in this granulite. The value is similar to that (1.68) of the spinel-bearing granulite. So that it is considered that granulite described herein was formed under the similar condition to the spinel-bearing granulites, *i.e.* 600—700°C.

In a separate paper (BANNO *et al.*, in press), we have pointed out that the original rock of the Iratsu epidote amphibolite was gabbro crystallized at high pressure, say, 12—18 K bars. The granulites described here is a part of the metamorphosed gabbro complex, and the banding of plagioclase-rich and pyroxene-rich layers may correspond to the banding in the gabbro. However, as discussed above, the rock in question belongs mineralogically to the granulite facies, thereby the Iratsu epidote amphibolite was metamorphosed twice after the consolidation of gabbro, *i.e.* granulite facies metamorphosed was followed by not directly confirmed, the Sanbagawa metamorphism.

The author would like to express his sincere thanks to Dr. S. BANNO for his continuous encouragement and the critical reading of this manuscript.

Reference

- BANNO, S., YOKOYAMA, K., IWATA, O and TERASHIMA, S., in press : Genesis of epidote amphibolite masses in the Sanbagawa metamorphic belt in Central Shikoku. (in Japanese)
- GREEN, D. H., 1964 : The petrogenesis of the high temperature peridotite intrusion in the Lizard area, Cornwall. *Jour. Petrol.*, **5**, 134—168.
- HORIKOSHI, G., 1937 : On the eclogite in the vicinity of Higashi-Akaishi Yama in the province of Iyo. *Jour. Geol. Soc. Japan*, **44**, 141—144. (in Japanese)
- MACKENZIE, D. B., 1960 : High temperature alpine-peridotite from Venezuela. *Bull. Geol. Soc. Amer.*, **71**, 303—317.
- PAMIC J., ŠCAUNIČAR, S. and MEDJIMORE, S., 1973 : Mineral assemblages of amphibolites associated with alpine-type ultramafics in the Dinaride ophiolite zone (Yugoslavia). *Jour. Petrol.*, **4**, 133—157.
- SHIBATA, T., 1972 : On the occurrence of anhydrite in the Iratsu ultramafic complex, Central Shikoku.

- Jour. Japan Assoc. Petr. Min. Econ. Geol.*, **67**, 76—83.
- TAYLER, T. P., 1967 : Chemical and structural relations of ultramafic and feldspathic rocks in alpine-intrusive complexes. In WYLLIE, ed.: *Ultramafic and related rocks*, 222—238. Wiley and Sons, New York.
- YOKOYAMA, K. and MORI, T., 1975 : Spinel-garnet two pyroxenes rock from the Iratsu epidote amphibolite mass in Central Shikoku. *Jour. Geol. Soc. Japan*, **81**, 29—37.
-

Plate I. A; Plagioclase-pyroxenes rock (PP) (granulite) in an epidote amphibolite (EA).
 B; Plagioclase-rich bands (PL) and pyroxene-rich bands (PY) in the granulite.
 C; Granulite (PP) in an epidote amphibolite (EA).
 D; Plagioclase in granulite (plane light). The rim of the plagioclase crystal (PL) is replaced by the aggregate of zoisite, kyanite and quartz (Z). PY=pyroxene.