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Low-grade Metamorphism of the Okanaro Group of the Kurosegawa Belt, Shikoku

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Introduction

The Kurosegawa Belt is a fault zone extending in the ENE—WSW direction from the Kii Peninsula through Shikoku to Kyushu in Southwest Japan. The main part of the Belt is exposed in Shikoku and is represented by trains of lens-shaped complexes which consist of various kinds of rocks (ICHIKAWA *et al.*, 1956; HADA, 1974). The rocks in the complexes are divided into the following four groups: 1) Terano high-grade metamorphic rocks consisting of garnet-biotite gneiss and amphibolite, 2) Mitaki plutonic rocks and their mylonites, 3) highly or completely serpentinized peridotites and 4) supracrustal rocks of the Okanaro Group. The last comprises ordinary clastic sedimentary rocks, rhyolitic volcanic and pyroclastic rocks, chert and limestone. The limestone is in plenty of the Silurian corals, conodonts and other fossils (HAMADA, 1959; KUWANO, 1976). Common occurrences of prehnite, pumpellyite and adularia in various kinds of rocks of the Okanaro Group indicate that low-grade metamorphism affected them.

This paper gives the microscopic petrography of the rocks containing these newly-formed minerals.

Petrography

The degree of metamorphic recrystallization in rocks of the Okanaro Group is so low that the various textures of the original sedimentary and volcanic rocks have well been preserved. Thin sections show clastic quartz and feldspar grains in sandstone and shale, phenocrysts and microphenocrysts in acid volcanic rocks and crystal grains in crystal tuff. The outlines of arcuate glass shards in vitric tuff and of radiolarian tests in chert have also been retained. Phenocrysts of ferromagnesian minerals in rhyolites have mostly been altered into pseudomorphs of chloritic material, although relic clinopyroxenes (Ca 42–43, Mg 36–38, Fe 20–21) have rarely been found in the pseudomorphs (HASHIMOTO *et al.*, 1976). On the other hand, interstitial part in sandstone and groundmass of volcanic rocks were more strongly recrystallized and transformed into fine-grained aggregates of such minerals as albite, quartz, chlorite, sphene, prehnite, pumpellyite and adularia. However, no schistose

texture can be observed in any rocks.

Figures 1 and 2 of Plate 1 show the aggregates of newly-formed pumpellyite, chlorite, albite and quartz in the interstitial part in sandstone and in the groundmass of rhyolite, respectively. Aggregates including minute grains of pumpellyite are also observed in some plagioclase phenocrysts as shown in Figure 3. The pumpellyite grains may have not been resulted from recrystallization of the phenocrystic plagioclase itself but derived from blebs of the groundmass material included in the phenocrysts. Figure 4 shows the prehnite-pumpellyite assemblage in mylonitized fine-grained part of rhyolite. The similar mineral association is also observed in irregular-shaped veins or pools in clastic sedimentary rocks as well as in volcanic ones (Figs. 5 and 6). In such cases white mica is fequently associated. The assemblage including adularia is found particularly in rhyolite and its pyroclastics. Figure 7 gives an example of adularia-albite-quartz vein in rhyolite. In this vein adularia overgrows on the associated albite crystal. In some vitric tuffs the potassium feldspar crystallizes throughout the whole rock (Fig. 8). As a result, bulk chemical compositions of the rocks become richer in K_2O than those of the ordinary rhyolites (HASHIMOTO *et al.*, 1976).

Discussions

The relevant metamorphic mineral assemblages observed in the studied rocks are summarized as follows.

Prehnite+albite+quartz+chlorite
Prehnite+albite+quartz+white mica
Pumpellyite+albite+quartz+chlorite
Pumpellyite+albite+quartz+white mica
Pumpellyite+albite+quartz+chlorite+white mica
Prehnite+pumpellyite+albite+quartz+chlorite
Prehnite+pumpellyite+albite+quartz+white mica
Prehnite+pumpellyite+albite+quartz+chlorite+white mica
Adularia+albite+quartz

These assemblages are typical of the prehnite-pumpellyite metagreywacke facies defined by COOMBS (1961). Accordingly, the rocks of the Okanaro Group are considered to have been suffered from metamorphism of this facies.

A few specimens of the Mitaki granite mylonite, which also constitutes a part of the Kurosegawa Belt, contain prehnite and pumpellyite along with albite, quartz, chlorite and sphene. Furthermore, mineral assemblages similarly indicating the prehnite-pumpellyite facies are also observed in ultramafic and associated mafic rocsk of this Belt as recently shown by YOKOYAMA (1977). Consequently, it is suggested that most groups of rocks in the Kurosegawa Belt may have generally been recrystallized under the conditions of the prehnite-pumpellyite facies. The nature of metamorphism seems to have been burial rather than dynamothermal, because no schistose texture has resulted in.

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Explanation of Plate 1

Fig. 1. Pumpellyite (pu) crystallized in interstitial part of a sandstone (NSM 102633). Feldspar sand grains are left and upper right. Nisashi, Nomura-cho, Ehime Pref.

Fig. 2. Pumpellyite (pu) crystallized in groundmass of a rhyolite (NSM 102470). Plagioclase phenocryst is upper left. Suberidani, Katsuura-cho, Tokushima Pref.

Fig. 3. Pumpellyite (pu) in plagioclase phenocryst of a rhyolite The same specimen as above.

Fig. 4. Prehnite (pr)—pumpellyite (pu) assemblage in mylonitized part of a rhyolite (NSM 102588). Oue, Niyodo-mura, Kochi Pref.

Fig. 5. Prehnite-pumpellyite vein in a siliceous shale (NSM 102630). A part of the host shale is seen at the lower left corner. Nisashi, Nomura-cho, Ehime Pref.

Fig. 6. Pumpellyite-white mica vein cutting through a plagioclase grain in a sandstone (NSM 102554). Yokokurayama, Ochi-cho, Kochi Pref.

Fig. 7. Adularia (ad)—albite (ab)—quartz vein in a rhyolite (NSM 102592). Oue, Niyodo-mura, Kochi Pref.

Fig. 8. Highly kalifeldspathized tuff (NSM 102681). Potassium feldspar shows the rhomb-shaped outline of adularia. Onji, Shirokawa-cho, Ehime Pref.

Length of bar is 0.1 mm for all the figures.

Numbers in parentheses indicate the registration numbers of specimens in the National Science Museum Petrological Collection.

Plate 1 HASHIMOTO: Low-grade Metamorphism of the Okanaro Group